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Experiment Station Work,

LIV.

Compiled from the Publications of the Agricultural Experiment Stations.

METHODS AND COST OF CLEARING LAND.
TOBACCO IMPROVEMENT WORK.
CALF FEEDING.
GASOLINE-HEATED COLONY BROODERS.
MEASURING ACIDITY IN CHEESE MAKING AND BUTTER MAKING.

SEPTEMBER, 1909.

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EXPERIMENT STATION WORK.

Edited by W. H. Beal and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. True, Director, Office of Experiment Stations.

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EXPERIMENT STATION WORK.[a]

METHODS AND COST OF CLEARING LAND.[b]

The problem of clearing logged-off land is an important one in various parts of the country, and although much of the farming is done upon land formerly occupied by forests, but little information regarding methods and costs of preparing this land for the plow has been recorded. Recently the Bureau of Plant Industry of this Department detailed Mr. H. Thompson to collect information from those who have had experience in this work in the Pacific Northwest, while the Mississippi Agricultural Experiment Station has issued a bulletin on the subject of clearing pine land containing the results of different methods tried there. The character of the clearing which is described by Mr. Thompson "ranges from the heavily timbered spruce and cedar lowlands through the benches and sidehills covered with fir stumps and a dense growth of underbrush to the more sparsely covered hemlock ridges." The information contained in these publications deals principally with the removal of stumps, which is the really serious problem of clearing land, and the methods described vary from grubbing the stumps out by hand to the use of the more costly and powerful mechanical devices.

Removing stumps by hand has proven a slow and costly method in the longleaf pine belt, while it is out of the question for the large stumps of fir and other trees up to 5 and 6 feet in diameter predominating in Washington and Oregon, and the principal up-to-date methods are burning, blasting, and pulling, or some combination of these. Burning is considered the best way to remove pine stumps, which have a large amount of turpentine, as this greatly assists in the process, and the long taproots of these trees are a great hindrance in

[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from Mississippi Sta. Bul. 118; U. S. Dept. Agr., Bur. Plant Indus. Circ. 25.

pulling. In regard to burning these stumps Mr. Ferris, of the Mississippi Station, says:

The common method * * * is to dig a hole about 12 inches deep with spade or post-hole digger on one side of the stump, as close to it as possible, and to use this as a furnace for firing the stump. In digging these holes it is necessary that the dirt be removed from as much of the surface of the stump as possible, so as to allow the fire to come in direct contact with the side of the stump for at least 6 inches. An ordinary turpentine dipper on a suitable handle makes one of the best implements for removing this dirt.

This is a rather slow process, but may be greatly hastened by boring a slanting hole through the stump from the opposite side to the fire hole. For boring, the Mississippi Station has used the simple machine shown in figures 1 and 2, invented by J. W. Day. It is thus described:

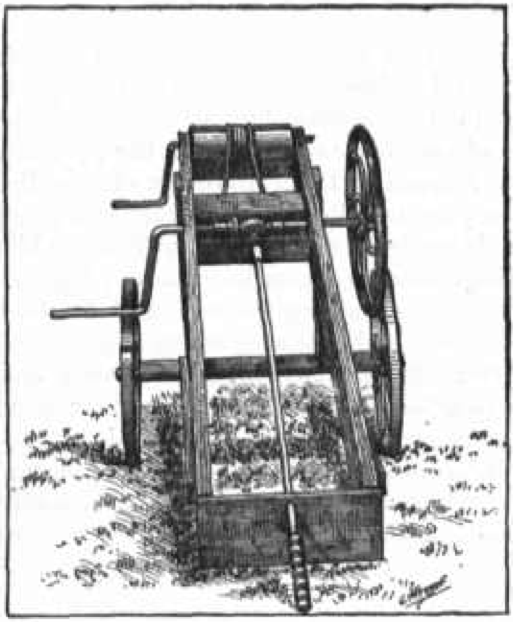

FIG. 1.—Stump auger, front view.

A 2-inch ship auger is welded onto one end of a ¾-inch iron rod 6 feet long. Four inches from the other end of this rod a collar is welded and the end of the rod passed through an iron box fastened to a movable frame about 18 inches square. A bevel gear is then fastened to the extreme end of this rod either by a key or set screw and works into a second gear of the same kind fastened on a horizontal shaft. This horizontal crank shaft is made of 1-inch iron rod bent at one end to form a handle, with a fly wheel fastened on the opposite end. It works through two boxes fastened to the movable frame and slides down the main frame as the auger bores into the stump. The upper end of the machine is elevated about 5 feet and stands on two cart wheels, on which it is easily rolled from stump to stump or from field to field by a single individual. This elevation of the frame helps to brace it against the stump in boring, raises the crank shaft to a height at which it can be most easily turned, causes a slight pressure to be constantly exerted against the auger, and makes it possible to bore the hole diagonally into the stump. At the extreme upper end of the frame is a small windlass with ropes attached which is used for pulling the auger out of the stump.

This machine was used to aid in clearing 2.3 acres of land which had been cut over about seven years before. The sapwood had decayed, but the balance of the stump above ground and all below was sound. On this plat there were 158 stumps that required boring. These aver-

aged 13.6 inches in diameter, and the length of hole bored averaged 19.7 inches, the total cost being less than $8 an acre, figuring labor at $1.50 per day.

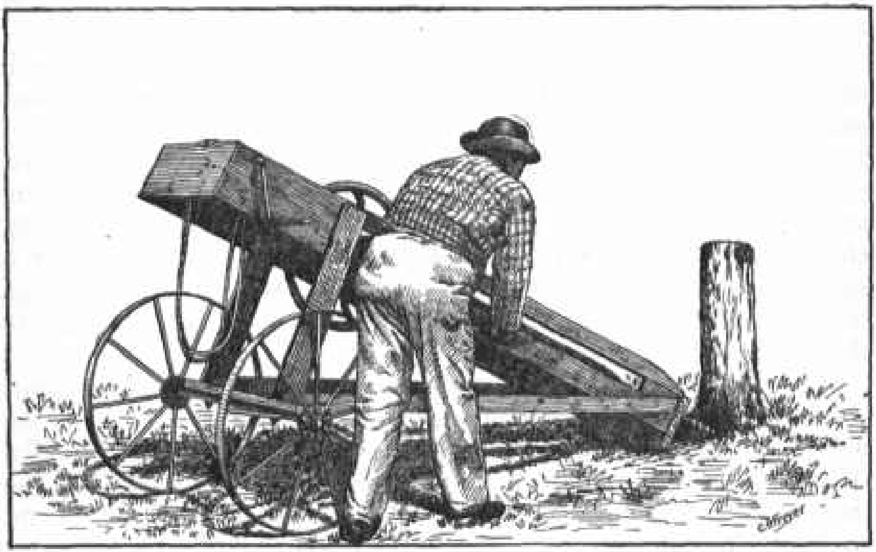

FIG. 2.—Stump auger, side view.

For burning the large stumps of fir, etc., in the Pacific Northwest, a quicker method is used, which consists of boring two intersecting holes, as in figure 3, and burning by starting a fire at the intersection

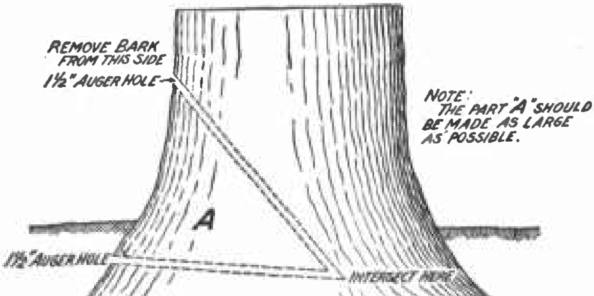

FIG. 3.—Method of preparing a stump for burning.

with the aid of red-hot coals or a piece of iron heated to a white heat. After the part marked "A" is burned out, the fire is maintained by filling the space with bark and litter. While the method first described generally results in burning the stump low enough to

allow of cultivating over it in the case of pine stumps, the method used on the western trees leaves the larger stringers with their smaller roots to be pulled out by team or puller, or "they may be entirely burned by digging away the earth and rolling a small log alongside of the root."

Other methods of burning are to split the stump with a small charge of powder and then kindle a fire in the hole thus made, and charcoaling or pitting. The latter, which consists essentially of keeping a smoldering fire around the base of the stump, is reported to be very economical for large stumps. Mr. Ferris says "removing stumps by this method [boring and burning] has been decidedly cheaper than by any other method tried, and as it requires only a small expenditure for machinery, practically no repair bills, and can be operated by a single individual, it ought to appeal strongly to the small farmers of this section."

It is stated that in the section reported on by Mr. Thompson scarcely anyone undertakes to clear even a small tract without the use of powder. Powder is also used on the pine stumps of Mississippi, the common method being to bore a 1½-inch hole from the surface of the ground diagonally downward for 10 to 20 inches and to insert in this from one-fourth to 1 pound of dynamite. This amount will shatter the general run of pine stumps, and makes the cost of this part of the work from 5 to 20 cents per stump. With stumps of the fir type, which do not usually root deeply, blasting is best done by placing several sticks of dynamite beneath the center on the hardpan, if not too deep, so as to cause the force of the explosion to be exerted upward.

Mr. Thompson gives the following data as to size of charge, under ordinary ground conditions, for shattering large stumps which are to be removed by stump pullers, blocks, or teams:

Diameter of stumps in inches	18	24	30	36	48	60	72
Sticks of powder	5	7	10	20	35	50	65

The sticks are 1½ by 8 inches, weigh a little over three-fourths of a pound, and cost from 10 to 15 cents a pound. The average cost of the removal of each stump from a tract of 120 acres containing fir stumps from 1 to 4 feet in diameter was reported as follows: Powder 49.76 cents, fuse 2.37 cents, caps 0.87 cent, labor 30.66 cents, total 83.66 cents. If dynamite is handled with ordinary care there is but little danger attached to its use except in cold weather, when it should be kept warm, preferably at about 70° F.

After loosening and shattering stumps by blasting, it is necessary to gather them into a pile for burning. This is usually done by means of a capstan or a donkey engine. The latter is reported to have found quite general application in the Northwest. A gin pole

is set up, as shown in figure 4, and the stumps drawn to it. When handled to advantage this method is considered to be timesaving and cheaper than hand methods. Another type of puller is the vertical derrick, which has the advantage of applying the pull in the best direction for stumps having long tap roots, but it is objected to on account of having to be moved for each stump.

It is evident that the method to be used should be governed by the character of stumps, the number on a given area, and also by the value of the land, more costly methods being justified for very valuable lands. Mr. Thompson gives in a table several instances of clearing costing $200 per acre, observing that only very rich land or that near centers of population will bear such a tax. The contrast be-

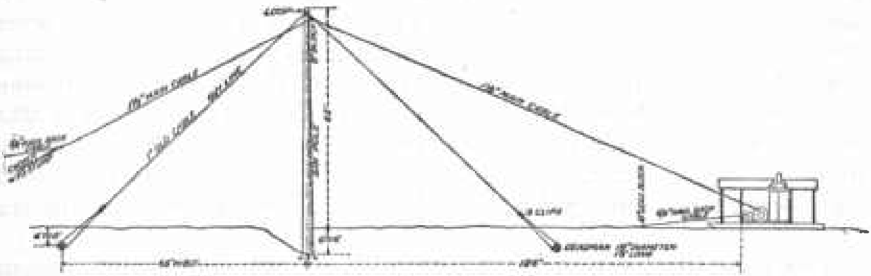

FIG. 4.—Method of setting donkey engine and gin pole in clearing land.

tween this figure and that of $8 per acre reported in the Mississippi bulletin serves to illustrate the wide range of conditions.

TOBACCO IMPROVEMENT WORK.[a]

In crop-improvement work tobacco is probably receiving fully as much attention as any of the cereals. The problem is approached from the plant-breeding as well as from the cultural side, and some of the results recently secured along both of these lines at several of the experiment stations in tobacco-growing States are here reviewed.

SHELTER-GROWN SUMATRA LEAF.

The Pennsylvania Experiment Station, at the request of the Lancaster County Tobacco Growers' Society, conducted experiments to determine whether by the aid of shelter tents wrapper leaf of the Sumatra type could be profitably produced in Pennsylvania. The earlier experiments showed that a thinner leaf was secured upon the light Penn sandy loam than upon the Norfolk gravelly loam, and

[a] Compiled from Pennsylvania Sta. Bul. 89; Virginia Sta. Bul. 175; Wisconsin Sta. Bul. 176. See also U. S. Dept. Agr., Bureau of Plant Industry Bul. 138; Yearbook 1908, p. 403.

that the leaf produced exhibited some defect in elasticity and burning quality, but possessed such good features as large covering power, fineness of vein, and good luster. The experiments were therefore continued to ascertain the influence of seasonal differences, the possibility of reducing the defects observed by modifying the selection and culture of the plants, and to determine the cost of producing such leaf. Accordingly, in 1905, one-sixth of an acre was grown under shelter at Milton Grove. Some of the ground had grown tobacco in 1903 and 1904, while part of it had produced wheat in 1903 and tobacco in 1904. The land was fertilized at the following rate per acre: Cotton-seed meal 1,350 pounds, carbonate of potash 200 pounds, dissolved South Carolina rock 700 pounds, a total of 2,250 pounds. The tobacco was transplanted to the shelter June 5 and 8, the fertilizer was spread broadcast and harrowed in June 25, the first suckering was performed July 17, some of the plants were ready for topping August 2, the ground leaves were ripe for picking August 9, while the main crop was not sufficiently ripe for priming until September 9, or 109 days from planting. On July 20 it was observed that the plants, all produced from selected seed, showed a great variety of form. The leaves of some of the plants resembled the Connecticut seed-leaf variety instead of following the Sumatra type.

The cost of the repairs to the shelter tent during the season amounted to $10.43, or $62.58 per acre. The expenditures for the production of the crop, exclusive of depreciation of shelter, cost of lath and cases, and the curing, taking down, sweating, and assorting of the leaf, amounted to $95.62.

At Cocalico, where a similar experiment was conducted, the expenditures amounted to $156.75, which is regarded as more nearly representing the probable cost of producing tobacco of this type under shelter than the expenditures made at Milton Grove. Here, as in the other tests, the plants also showed a great diversity in leaf form. This was especially true of the plants grown from the Connecticut Sumatra seed, while the plants produced at Cocalico the previous year exhibited a higher quality. In general the plants from commercial seed showed great diversity of type, while those from self-fertilized seed grown in Pennsylvania in 1904 showed a marked uniformity. Crops of cured leaf weighing 1,200 and 1,700 pounds per acre were secured at Milton Grove and Cocalico, respectively.

Sweating and assorting caused a loss of 21.7 per cent. The tobacco was bulked February 16, 1906, and the temperature rose from 70° F., at that time to 100° on February 25, and fell back to 96° on March 2. The bulk was turned March 3, and on the following day the temperature was 84°, on the 12th 100°, and on the 17th 92°. After thirty days from February 16 the bulk was taken up and assorted.

The cured leaf consisted of about 75 per cent of wrappers and 25 per cent of seconds. Forty-five per cent of the wrappers were light, 30 per cent medium, and 25 per cent dark. Sixty per cent of the leaves were over 16 inches long. In capacity, life, and burning quality the crop of 1905 was superior to that of 1904 and showed a general rating above all domestic Sumatra type tobacco, except the better Georgia and Florida grades. The cured leaf was produced at Cocalico at a cost of 45 cents per pound, and it is believed that the cost of producing the sweated and assorted leaf should not be over 65 to 70 cents per pound. It is stated that the yield per acre may reach as high as 1,600 to 1,700 pounds of cured leaf, and that under these conditions and with the present market prices the application of skill and enterprise to the culture of this crop should result in profit. It is believed that the chances for success are conditioned by the rapid development of the Florida culture of Sumatra type shelter-grown leaf and upon the conduct of the business with sufficient capital to procure the necessary skilled help and to make the requisite fixed investment.

CULTURE OF DARK TOBACCO.

The Virginia Station has reported results with experiments in crop rotation and fertilization, carried on in cooperation with this Department. A crop rotation for the dark-tobacco belt of the State as suggested is based upon tobacco as the leading crop, being followed by wheat, which in turn gives place to grass. After the grass crop corn is grown, which is followed by cowpeas. This rotation may be made to cover a period of five or six years by leaving the land in grass either one or two years.

At Appomattox, where this work is in progress, a plat without fertilizer yielded 810 pounds of tobacco per acre, valued at $56.19; a plat fertilized with 800 pounds per acre of the common 3–8–3 fertilizer yielded 1,070 pounds per acre, valued at $82.18; a plat fertilized with 500 pounds per acre of nitrate of soda yielded 1,280 pounds per acre, worth $93.20; a plat receiving per acre ground fish 1,000 pounds, nitrate of soda 150 pounds, acid phosphate 200 pounds, bone meal 100 pounds, sulphate of potash 200 pounds, costing $32, yielded 1,650 pounds per acre, valued at $154.37.

In 1906 wheat, after a highly fertilized crop of tobacco, yielded 21 bushels to the acre, while after tobacco fertilized with 400 pounds of 3–8–3 fertilizer only 8 bushels were secured. In 1907 the yield of wheat after the crop of tobacco having received the heavy mixed application was 29 bushels per acre, and after a crop which had received only 400 pounds per acre of the usual 3–8–3 fertilizer 12 bushels per acre. No fertilizer was applied to the wheat except that the fields were limed for the benefit of the succeeding grasses.

States were represented by the samples tested showed the wide extent of this adulteration in the retail trade at the time mentioned.

It is gratifying to note that tests covering 343 samples sold as orchard grass in 1908 showed but 53 samples, or 15.45 per cent, to be adulterated. In these cases meadow fescue and English rye-grass seed were chiefly employed. In two instances chess seed was used, amounting to nearly 18 per cent in one case and nearly 23 per cent in the other. In one instance over 21 per cent of the sample consisted of Canada bluegrass seed.

Chaff screenings containing little matured orchard grass seed but having the appearance of good seed make up a considerable part of some lots of seed. Such seed is essentially adulterated, and, furthermore, as a rule the screenings carry various weed seeds.

MEADOW FESCUE SEED.

Chess, or cheat, is one of the commonest impurities of meadow fescue seed, varying in quantity from a trace to 5 per cent or over. (See fig. 11, *b*, *d*.) One sample examined at the Seed Laboratory contained over 16 per cent of chess; three others contained over 19 per cent. In each of these four instances adulteration was suggested not only by the large quantities of chess but also by the presence of English rye-grass seed, which is sometimes used as an adulterant of meadow fescue seed. (See fig. 11, *b*, *c*.) In one of these cases over 62 per cent of the lot consisted of English rye-grass seed. The mistaking and substitution of chess for meadow fescue seed is mentioned in Press Bulletin No. 25 from the Nebraska experiment station; also in Kansas station Bulletin No. 141.

While meadow fescue seed is cheaper than that of orchard grass and is used as an adulterant of the latter, it often contains orchard grass seed, sometimes in considerable quantity. Old, worthless orchard grass seed or screenings being cheaper than the fescue seed may be used in adulterating the latter.

KENTUCKY BLUEGRASS SEED.

The chief adulterant of Kentucky bluegrass seed is the seed of Canada bluegrass, so called because it is produced chiefly in Canada. This is an inferior kind of true bluegrass not adapted to the purposes or crop requirements of Kentucky bluegrass. It grows spontaneously, however, throughout the eastern United States. It often appears in crops of Kentucky bluegrass harvested for seed. Since the Canada bluegrass matures its seed several weeks later than the Kentucky bluegrass its mature seed does not appear in the Kentucky bluegrass seed crop as it is ordinarily harvested. Immature Canada bluegrass chaff sometimes appears, however, in chaffy samples of

Kentucky bluegrass seed. Most, if not all, of the Canada bluegrass seed used in the trade is imported from Canada. As there is very little legitimate demand for it these importations are mostly for use in adulteration. The close resemblance existing between the seeds of these two bluegrasses permits the complete substitution of the inferior kind for the other with little danger of detection by purchasers. (See fig. 7.) The seed of Canada bluegrass costs from one-third to one-half as much as Kentucky bluegrass seed.

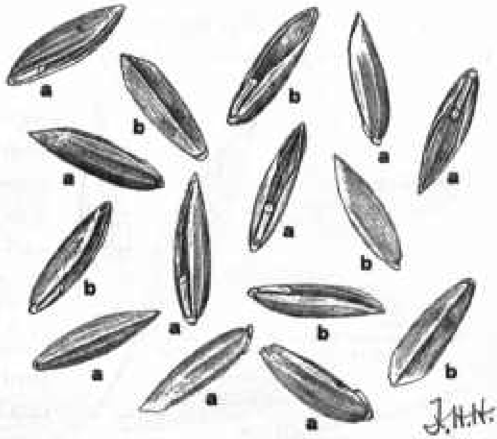

FIG. 7.—Mixture of seeds of Kentucky bluegrass (*a*) and Canada bluegrass (*b*). The Kentucky bluegrass seeds are broadest at the center, pointed, and have a distinct ridge on each side. Canada bluegrass seeds are mostly broadest near one end, blunt, and smooth on the sides. (Enlarged.)

Tests made at the Seed Laboratory and at various experiment stations show that much adulterated Kentucky bluegrass and Canada bluegrass seed substituted for Kentucky bluegrass seed is on the market. Of 251 samples of seed sold as Kentucky bluegrass which were examined at the Seed Laboratory in 1905, 41 samples, or over 16 per cent, were found to be adulterated with Canada bluegrass seed. Tests of 357 samples of seed sold as Kentucky bluegrass seed in 1908 showed 39 samples, or nearly 11 per cent, to be adulterated or misbranded. In 14 of these samples other seed had been substituted for the proper seed, Canada bluegrass seed being used in 12 instances and meadow fescue, or English bluegrass, seed in the other 2.

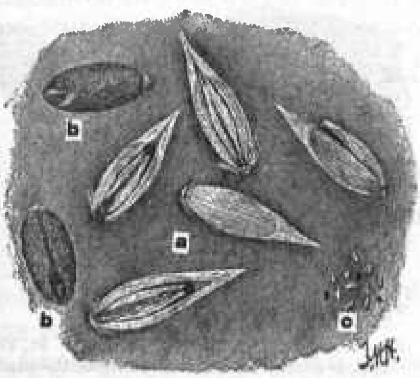

FIG. 8.—Seeds of redtop representing the "fancy" grade of the trade: *a*, different views of seeds having the white, papery, inner chaff; *b*, two views of a grain, or kernel, with the inner chaff removed; *c*, the same, natural size.

Poorly cleaned Kentucky bluegrass seed is likely to contain much light chaff devoid of seed. The deceiving nature of such chaff renders its use equivalent to adulteration.

The careless methods employed in curing Kentucky bluegrass seed followed by some producers results in killing much of the seed by overheating. Since such dead seed maintains the weight of good

separated so that they will not come in contact with each other. Then place the other blotter over the seed, and finally invert another saucer over the blotters. The tester should be kept in a warm place having a uniform temperature from 65° to 75° F. At the end of ten days open the tester and count the seeds which have sprouted. Care should be taken in removing the top blotter so as not to spill any of the seeds as they may adhere to its surface. After counting the percentage of germination, the remaining seeds should be left for a few days longer and again counted. The number obtained from the two countings is the percentage of germination. The tester should be examined daily to see if the blotters are drying out; if they are, small quantities of water should be introduced at the edges of the blotter.

Much stress is laid on the selection of the plants in the seed bed, as this is regarded as really the starting point. The ordinary practice of taking the plants from the seed bed at three or four different times as they grow large enough is not recommended. The first plants are the strongest and most vigorous, and hence the best to plant.

CALF FEEDING.[a]

The question of substitutes for whole milk for feeding calves is one that is of much importance, especially to dairy farmers. In cases where skim milk is available it becomes a question of substitutes for the butter fat that has been taken out of the whole milk. The availability of various substitutes that have been found fairly satisfactory depends on the purpose for which calves are intended. If calves are intended for veal, then it is desirable to feed to obtain as large a gain in weight with as good appearance as possible in the shortest possible time; if the intention is to raise the calves to maturity, it is desirable to bring them to the point where they can take care of themselves, that is, where they have learned to eat and digest coarse feed in quantity sufficient to maintain satisfactory growth with the least possible expense and labor.

Some years ago a number of the stations studied the question of substitutes for the butter fat taken out of whole milk and reached conclusions, agreeing in the main, in favor of some sort of a grain ration to supplement the skim milk. These conclusions have been noted in previous bulletins of this series.[b] With the increasing prices of grain the possibility of finding a cheaper substitute seems extremely desirable.

The Louisiana Station conducted an experiment "to determine whether or not low-grade sugar-cane molasses (blackstrap) could be used as a supplement to skim milk * * * for calf-feeding purposes."

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[a] Compiled from Illinois Sta. Circ. 118; Louisiana Stas. Bul. 104; Massachusetts Sta. Rpt. 1908, p. 103; New York Cornell Sta. Bul. 269; North Carolina Sta. Bul. 199; Virginia Sta. Bul. 172; Ontario Agl. Col. and Expt. Farm Rpt. 1903, pp. 73, 74.

[b] U. S. Dept. Agr., Farmers' Buls. 84, p. 20; 92, p. 21; 233, p. 22.

The following conclusions were reached:

On account of its laxative effect, "blackstrap" molasses can not be used as a supplement to skim milk for calf-feeding purposes in sufficient quantity to be of any practical value.

This laxative effect is due to the sugar content, rather than to any of the other constituents of the "blackstrap."

Scouring is caused by the fermentation of the sugar in the digestive tract.

Salt and tannin have a beneficial effect, but will not prevent scouring.

The same station also reports a method of feeding calves in which milk is dispensed with entirely after the first few days.

The calves are taken from their dams a day or two after birth and taught to drink from a pail. They are then given 5 to 8 pounds of their mother's milk twice a day until the milk is fit for human use, which of course will vary with the different cows, but on the average * * * the milk [may be saved] on the fifth day after calving. The milk is then reduced until at the end of ten days the calf is receiving 1 pint of milk twice a day, and this amount of milk is fed until the calf is 6 weeks of age, when the milk is discontinued entirely. At the same time that the milk is being reduced, bean soup, shorts, blood meal, and sometimes cotton-seed meal are added to the calf's ration until at the end of ten days it is receiving twice daily, in addition to its pint of milk, bean soup from 4 ounces of navy beans, 3 ounces shorts, 1 ounce blood meal, and probably about half the time 3 ounces of cotton-seed meal. The calf receives this ration until it is 6 weeks of age, when the milk is discontinued and the same amount of the substitute fed as before until the calf is 4 months old, when it is weaned; that is, put on dry feed entirely. The calf is encouraged to eat hay as soon as it will.

Alfalfa hay is preferred, with peavine hay as second choice, and calves "have access to grass whenever there is any."

It is thought that failures in the use of this plan are due to faulty preparation of the bean soup, and the following method is recommended as likely to give success:

Parboil the beans in soda, then drain off the water and boil again until soft. Squeeze through a colander and add salt until the soup has a decidedly brackish taste. Stir in the shorts, blood meal, and cotton-seed meal and add lukewarm water until each calf receives about 3 quarts of the mixture. Of course the amounts to be given will vary with different calves. The above figures are the average for strong grade Holstein calves. The cost of the milk substitute is between 4 and 5 cents per day.

The Virginia Station has carried on feeding trials designed to compare the value of different grains as a supplement to skim milk.

The grains used in this trial were: Shelled corn, shelled corn and bran, 4 parts of the former to 1 of the latter by weight; corn meal and bran in the same proportion, and cracked barley and bran also in the same proportion. Shelled corn is probably the most available grain for calf feeding, and it seemed desirable to secure some data as to its value in supplementing skim milk, as compared with a combination of shelled corn and wheat bran. Wheat bran has become so expensive in the last few years that it is advisable to substitute a cheaper foodstuff as far as possible. It was also thought desirable to secure a comparison of the whole grain with the same grain in the form of meal. Barley has not been raised or fed very extensively in the South, but on land suitable to its growth it gives a good yield and is a very valuable foodstuff.

Six groups of four calves each were used, groups 1 to 4 being dairy bred and the other two of beef breeds, and the groups were made as nearly uniform as possible.

The method of feeding was as follows:

The calves were confined in stanchions * * * while the skim milk and grain were fed; after this they were allowed the run of the barn with access to the hay rack at all times. The skim milk was fed first, in round-bottomed buckets, and immediately afterwards the grain; the grain and skim milk were never mixed together. It is important that the milk and grain be fed separately, as it is much better masticated, and the digestive juices have a much better chance to do their work. It is probable that some of the failures in feeding calves on skim milk are due to mixing grains that do not go into solution with the milk. The calves were fed for the first week on whole milk, then the skim milk was gradually substituted for it. They would usually begin to eat the grain and hay at 10 to 12 days old. It was found that the calves learned to eat the ration containing bran somewhat quicker than they did that of shelled corn alone. Care was taken that the skim milk be fed fresh. A small hand separator was used at the barn, and the milk was taken directly from the cow to the separator, and fed in a very short time after separating. It was found that when handled in this way, only in the very coldest weather was it necessary to use any artificial heat.

The calves were fastened at feeding time to save the time of the feeder and to keep them from each other until their noses were dry, and also because it was found that they learned to eat more readily in this way.

The following rules were observed in feeding the calves and were found quite satisfactory: Ten pounds of milk for the first 100 pounds of live weight, 5 pounds of milk for the second 100 pounds of live weight, and 2.5 pounds of milk for the third 100 pounds of live weight. Until the calf was 3 months old 1 pound of grain to 10 pounds of milk was fed. From 3 to 6 months old 1 pound of grain to 5 pounds of milk was fed. * * *

The grain consumed per day varied from 2.04 pounds with the group receiving shelled corn and bran to 2.25 with the group receiving shelled corn alone. [The] group which received shelled corn and bran consumed the smallest amount of skim milk, while [the] group which was fed barley and bran consumed the highest amount. There was slightly more variation in the amount of hay than of grain. The amount of grain per pound of gain only varied 0.09 of a pound. It is evident from this that there is no practical difference in the amount of grain required per pound of gain. A gallon of skim milk for each pound of gain was consumed. * * *

Bran was used to great advantage in teaching the calves to eat grain, but no advantage was secured from adding bran to a ration of shelled corn to supplement the skim milk, either in rate of gain or the appearance of the calf. The best results were obtained from shelled corn. The calves did not consume as much corn meal per day as shelled corn, nor did they make as large a rate of gain. It did not require as much shelled corn as corn meal per pound of gain. Barley was found to be an excellent grain to supplement skim milk, but owing to the high market price of the barley as compared with corn it did not show as good returns financially. However, it must be borne in mind that barley can be produced pound for pound as cheaply as the corn. * * *

The importance of hay for young calves can not be emphasized too strongly; they should have access to good, clean hay at all times.

The cost per day varied from 5.4 cents to 6 cents; or from about $1.60 to $1.80 per month. The cost per pound of gain was lowest with the beef-bred calves receiving shelled corn and bran, 3.29 cents; and highest with the dairy-bred calves receiving barley, 4 cents.

The increase in weight per head per day with the dairy-bred calves varied from 1.42 pounds with those receiving corn meal to 1.60 pounds with those receiving shelled corn. The increase per head per day was 0.2 greater with the beef-bred calves than with the dairy-bred calves receiving the same ration.

The group of calves fed whole milk made the largest gain, but at the highest cost per day and per pound of gain. They presented a better appearance before weaning, but at 8 months of age there was little difference either in weight or appearance between those developed on whole milk and those on skim milk.

The formaldehyde treatment[a] for scours has been used with great success, not only with the calves in this experiment, but with a large number of others.

In raising calves to keep up a dairy herd the cost may run higher, as the number to be fed would be limited to the best individual offspring of the highest income-producing cows and would therefore vary from year to year and would never be a large number. Then, too, it must be remembered that the value of such calves is to be calculated on what they will produce when they become cows.

The Massachusetts Station reports that the one or two calves raised yearly to keep up the dairy herd cost, for feed, from $40 to $45 up to the time they are 2 years old. They are pastured in summer and in winter fed hay, silage, and 2 or 3 pounds daily of a mixture of bran and fine middlings.

In a circular of the Illinois Station, W. J. Fraser gives the results of some experiments carried on at that station to determine whether or not it was true, as some dairymen had said, that raising their own stock is not worth while.

Twelve calves at a time were tested at four different times. It was found they could be successfully raised on 150 pounds of whole milk and 400 pounds of skim milk. This milk was fed at the rate of 10 pounds per day until the calves were 50 days old, when it was gradually lessened 1 pound per day for 10 days, and then no more was fed. No substitutes for milk were used. Only ordinary grains which the farmer produces, and a good quality of legume hay were fed, showing that the dairymen can raise a calf in this way with almost no extra trouble. Several of these calves are now cows in milk and good producers, indicating that they were not injured by this method of raising.

The sale value of the milk fed these calves was as follows:

150 pounds whole milk, at $1 per 100	$1.50
400 pounds skim milk, at 30 cents per 100	1.20
Total	2.70

And these prices of milk are liberal, especially as they are paid at the farm, and no money or labor is expended in hauling the milk to market. It is not so expensive to raise a calf as the dairymen have thought. The grain and hay consumed by the heifers of high quality will give much better returns than the same feed fed to cows.

[a] U. S. Dept. Agr., Farmers' Bul. 273, p. 17.

A prominent and successful dairyman of the State says that he can raise a heifer to the age of 2 years at a cost of $20, including the value of the calf at birth, and he has been offered $50 for some of his heifers at that age.

Another dairyman who has successfully managed a large herd of cows for several years estimates that it costs about $18 a year to raise the average calf.

But even allowing $40 to raise a heifer to the age when she begins to give milk, she will then be the equal of cows that could be bought for $60. Here is a clear advantage of $20 per cow in raising over buying, but the actual added profit in the life of the home-raised and well-raised cow is more apt to be two or three times this amount. * * *

Another great advantage in raising the heifers is that the owner may feed his calves in the correct manner to develop them to their greatest capacity. Cows that have been properly raised are much more efficient, and therefore worth more than if they had not been so raised.

John Michels experimented at the North Carolina Station with rolled oats as a partial substitute for milk in calf feeding with especial reference to the needs of dairymen who have little or no skim milk.

The rolled oats were prepared by adding boiling water to them at the rate of 1 gallon of water to 12 ounces of rolled oats, and the mixture was then allowed to stand until cool enough to feed. * * *

The daily allowance per calf during the thirteen weeks of the experiment was as follows:

First week—10 pounds whole milk.
Second week—8 pounds whole milk, 4 ounces rolled oats.
Third week—6 pounds whole milk, 8 ounces rolled oats.
Fourth week—4 pounds whole milk, 12 ounces rolled oats.
Fifth week—2 pounds whole milk, 12 ounces rolled oats, 0.2 pound grain mixture.
Sixth week—2 pounds whole milk, 12 ounces rolled oats, 0.4 pound grain mixture.
Seventh week—2 pounds whole milk, 12 ounces rolled oats, 0.6 pound grain mixture.
Eighth week—2 pounds whole milk, 12 ounces rolled oats, 0.8 pound grain mixture.
Ninth week—2 pounds whole milk, 12 ounces rolled oats, 1.0 pound grain mixture.
Tenth week—12 ounces rolled oats, 1.0 pound grain mixture.
Eleventh week—12 ounces rolled oats, 1.0 pound grain mixture.
Twelfth week—12 ounces rolled oats, 1.2 pounds grain mixture.
Thirteenth week—12 ounces rolled oats, 1.2 pounds grain mixture.

The grain mixture consisted of one part each of corn meal, linseed meal, and wheat bran.

The milk was always added to the oat preparation just previous to feeding.

In addition to the above feeds, the calves received all the hay they would eat during the winter, while in spring they received one feed of hay with pasturage additional.

On the basis that 1 pound of rolled oats is equal to 1 gallon of whole milk, and that whole milk is worth 8 cents per quart to milkmen, the cost of the milk for a 13-weeks-old calf receiving no rolled oats is $26.96. When rolled oats (which cost 4.4 cents per pound delivered in barrel lots) are substituted for milk as shown above, the cost of the calf feed for the same period is only $12.46, a saving of $14.50 in favor of the rolled oats. * * *

One thing that especially commended itself in the rolled-oats feeding was the evident relish with which the calves devoured them. The extra labor entailed in the feeding of the rolled oats was insignificant as compared with the saving effected.

One precaution to observe in feeding rolled oats to calves is not to use it in too large quantities, owing to the laxative character of this feed. Indeed, our experience indicates that it is best not to feed more than 12 ounces daily to each calf. It is important also that the rolled oats and milk be supplied as near the temperature of blood heat as possible.

The average gains made were slightly better for the calves fed rolled oats than for the calves fed skim milk, and good development was shown.

The New York Cornell Station conducted experiments with three lots of calves in 1907–8 and with four lots in 1908–9, with a view to finding a satisfactory substitute for skim milk.

The feeds compared were skim milk, skim-milk powder, and three commercial calf meals. The calves were fed all the dry grain they would eat up clean. This grain was a mixture made up as follows: 6 pounds of corn and oats, ground half and half by weight; 3 pounds of wheat bran; and 1 pound of oil meal. The cost of the mixture was $29.55 per ton. A mixed hay, with a good percentage of clover, was kept before the calves at all times.

It was found that a tablespoonful of soluble blood meal mixed with each feed kept the bowels of the calves in good condition at a small expense.

Only one of the commercial calf meals used gave satisfactory results from the standpoint of cost, and even that gave an average cost per pound of gain of 8 to 9 cents.

The results for the two years are summarized, in part, as follows:

(1) It is evident from the results of these experiments and those elsewhere that good, strong, healthy calves can be raised without skimmed milk or milk of any kind after the first thirty days.

(2) Skimmed milk, hay, and grain make the best substitute for whole milk in raising calves. A calf fed on skimmed milk should reach a weight of 300 pounds at five months of age, and the gain should be made at the rate of 1½ pounds per day, at a cost of less than 5 cents per pound.

(3) If skimmed milk is not at hand, the best substitute for it seems to be third-grade dried skimmed-milk powder. The average gains made in this experiment were not so large as with the skimmed milk, but were good. A calf fed on this food should reach a weight of 250 to 260 pounds at five months of age, making an average gain of 1.25 pounds per day at a cost of less than 6½ cents per pound.

Professor Dean, of the Ontario Agricultural College, tried a decoction of cocoa shells as a substitute for skim milk and obtained satisfactory results; 0.25 pound of the cocoa shells was boiled in 2 gallons of water and 1.5 to 2 gallons of the decoction were fed daily together with some grain and green feed. While the gains were not as large as with skim milk, the conclusion was drawn that this decoction "appears to be a very good substitute for skim milk and is worthy of a trial by those farmers who wish to rear calves and have little or no skim milk to feed."

The subject of artificial feeds for calves has been and still is being studied by many foreign investigators.

Cod-liver oil has been fed successfully as a substitute for the butter fat taken out by the separator, according to reports of Scotch and Irish experiments; it was fed at the rate of 2 ounces to 10 pounds

of separator milk. It was found that the calves fed this combination did not gain quite as much as those fed whole milk up to the time of weaning, but after that the oil-fed calves made greater gains than the others. The cost of the combination ration was about half that of whole milk.

A recent Brazilian report gives the result of the feeding of 6 calves from birth to the age of 6 months. The calves were of European breeds and received especial care, since it is desired to establish a herd adapted to the climate of Brazil. The calves were taken at once from their dams and fed from a pint to a pint and a half of milk four times a day, each calf receiving the milk from its own dam. After the first week milk from the herd was fed. Four feedings a day were given for three weeks, and then 3 feedings till the end of the third month. The calves were weighed every week and the feedings increased in accordance with gain in weight. Gains averaged 1¾ pounds daily and were extremely uniform throughout the period. At the end of the second month the whole milk began to be replaced by skim milk, to every quart of which was added about 3½ ounces of either corn meal, cassava meal, or good wheat bran. The whole milk was gradually replaced, until at the end of the third month no whole milk was fed. It should be understood that the periods of time given are not exact, but varied slightly according to the progress and needs of the individual calf. A little grass and hay was fed from the beginning of the third month and gradually increased. Little trouble was had with scouring, and it was readily controlled by giving on two successive days one-half ounce of sulphate of soda, followed on the third day by 15 grains of salol.

In Italy the experimental work reported has been mostly along the line of trying various supplements to skim milk, especially for veal. A recent report compares the results of feeding 6 groups of 4 calves each. One group was fed whole milk, the other 5 groups were fed skim milk with the following additions: Rice flour, corn meal, starch, oleomargarine, and whole milk. For the 5 groups there were 3 feeding periods. The first began at birth and lasted from eighteen to twenty-five days, according to the progress and condition of the individual calf. During this period whole milk was fed. The second period was a transition period, in which the whole milk was replaced by skim milk and the various supplements at the rate of a quart a day. The third period lasted from thirty to forty-eight days, and during this period no whole milk was fed. In the first period the calves were fed three times daily, in the other two periods only twice, the midday meal being gradually decreased, and finally omitted. The rice flour and the corn meal were mixed with part of the skim milk and added to the remainder just as it came

to the boiling point. The mixture was then boiled about fifteen minutes, being stirred constantly to prevent lumping or sticking to the vessel. The starch was made into a thin paste with cold milk and then added to the rest of the milk when it was at about 145° F., and the mixture slowly raised to the boiling point, then quickly removed from fire. In case the mixture was too thick it was cooled quickly by placing the vessel in cold water. The oleomargarine was added to the skim milk by means of a commercial emulsion. The proportion of skim milk to whole milk in the case of the fifth group was 1:1 and 2:1. The temperature of feedings was about 94° F. The starch was fed in the proportion by weight of from 3 to 5 parts to 100 parts of skim milk. The rice flour was added in the proportion of 5 to 9 parts to 100 parts of skim milk. It was found that the lower proportion gave satisfactory results, but more than that produced serious digestive disturbance. The proportion of corn meal to skim milk was 5–6:100 and of oleomargarine 2–3:100. During the last period salt was given with each feeding at the rate of 0.3 ounce per 100 pounds of live weight. The amounts fed were determined by the condition and progress of each animal, and varied from one-tenth to one-sixth of the live weight.

The conclusions reached may be summarized as follows: All the groups gave satisfactory financial returns. The smallest return for the skim milk fed was 73 cents per 100 pounds and the largest $1.39 per 100 pounds, while the average ranged from 87 cents to $1.16 per 100 pounds.

The groups fed corn meal and starch kept in the best condition, while the meat of the starch-fed group was slightly superior to that of any other of the artificially-fed groups. The condition of the group fed oleomargarine was next, and that of the group fed rice flour was poorest. As for the two groups fed whole milk and a mixture of whole milk and skim milk, both groups kept in excellent condition, but the meat of the group fed whole milk was fatter.

The same investigator later conducted a similar test under conditions more nearly like those that would obtain in ordinary farm practice. The results were satisfactory but the returns were somewhat smaller, the lowest return for the skim milk fed being 64 cents per 100 pounds and the highest $1.34 per 100 pounds.

In Austria considerable study of different phases of the calf-feeding problem is reported. One writer lays especial stress on the necessity of letting calves run in a good pasture when they are to be raised to replenish herds. This seems especially necessary for high-bred stock in order that a good foundation of health may be laid.

Another report says that a 3½ per cent emulsion of palm oil may be profitably used as a substitute for the butter fat taken from whole

milk. Figures are given showing a saving of 1⅓ cents per quart of whole milk after allowing for labor and depreciation of machine. This method involves considerable labor as well as an emulsifying machine, so that it would doubtless be practicable only on a large scale.

Numerous German experiments in artificial calf feeding have been reported. Homogenized milk is said to be valuable for feeding calves, owing to its digestibility, but it would seem available only when there is no convenient market for butter fat. Linseed-oil cake has been found of value as an addition to skim milk, as it is reasonable in price and has a good effect on the digestion.

One experiment reported was a comparison of whole milk, skim milk, and skim milk with the addition of peanut oil or flaxseed or starch. It was found that skim milk gave as much increase in body weight as whole milk, but the valuable digestive qualities due to the fat in whole milk were lacking. Flaxseed as a substitute for the fat of whole milk gave the best results both in increase of body weight and in digestibility. It is prepared by thorough soaking in hot water. About one-third of a pound is given at a feeding. Peanut oil in emulsion worked well but not in too large doses. Equal parts of peanut oil and warm water and a small amount of a commercial emulsive preparation were shaken until thoroughly mixed, and of this emulsion not over two-fifths of a pint was given at a feeding. Starch paste made as previously described did not help the digestive disturbances caused by skim milk. About one-fourth of a pound was the quantity given at a feeding.

There are numerous reports on the value as an addition to skim milk of starch inverted with diastasolin; this is a commercial preparation made from malt which has the property of transforming starch into dextrin and then into sugar, thereby increasing the digestibility of the starch. A pound of starch is mixed with a quart of cold water and the mixture is slowly added to 3½ quarts of boiling water, thus forming a thick paste which must be stirred constantly to prevent lumpiness. After the paste has cooled to 110° F., about two-thirds of an ounce of diastasolin is added, dissolved in a little lukewarm water. The thick paste becomes thin through the action of the diastasolin in about half an hour. Of this mixture about 1⅓ ounces to a quart of skim milk is fed. Good results are reported from the use of this mixture, but it is laxative in effect and care must be taken not to give too much of it. This mixture may be prepared in quantity sufficient to last three days in winter, but in summer it must be prepared every day.

An English writer states that calves raised on whole milk for veal should not be kept as a rule more than a month and should be fed

three times daily. It is noted that boxes in which calves are kept should be light and well ventilated. Unless the very highest prices are obtained for veal it is not found profitable to feed whole milk.

In France experiments are being made all the time with various supplements to skim milk. Many of these are the same as those already mentioned. There is some discussion as to the value of pasteurization in connection with calf feeding, but it would seem that for the small farmer it is not worth while.

It has been found that denatured sugar forms a valuable and economical addition to skim milk for calves. Denatured sugar is sugar to which various ingredients have been added for the purpose of rendering it unfit for human consumption. It is claimed that, contrary to general belief, it does not have an injurious effect on the digestive organs; on the contrary, that its solubility renders it more digestible, and that it has a high food value. The amount fed at first is 1 ounce per quart of skim milk, and it is claimed that it can be fed to calves ten days after birth without danger. At first not over 3½ ounces is given at a feeding, but afterwards the amount may be raised to 1½ ounces per quart of skim milk. Of 2 lots of 4 calves each fed on skim milk supplemented by starch and denatured sugar, the respective profits averaged $13.24 per calf in the lot fed sugar and $6.12 in the lot fed starch. The calves were kept an average of ninety-five days.

In conclusion attention may be called to a few important points: In selecting a supplement to skim milk the farmer will have to be governed by local conditions; that is, use what is most available. It must be remembered that most of the supplements require considerable labor for their preparation. Great care must be used in adapting the artificial ration to individual calves. In this connection it should be remembered that it is very desirable to feed calves separately. Finally, it seems to be well established that for the production of absolutely first-grade veal nothing will take the place of whole milk, but to justify its use fancy prices must be obtained for the product.

GASOLINE-HEATED COLONY BROODERS.[a]

The use of gasoline to develop heat for brooders has been worked out with a great deal of care at the New York Cornell Station, and has many points to commend it to those who raise poultry on a fairly large scale; the system involves broods of 200 chicks, so that it is not suitable for those who have only small hatches.

The principal advantages in using gasoline rather than kerosene are to secure a higher temperature when needed without forcing the

[a] Compiled from New York Cornell Sta. Bul. 246.

heater and to save time and labor by having one brooder house serve for 200 chicks instead of 50. The form of house used is what is called the "A" type (fig. 5) and is constructed as follows:

The "A" type of house is 8 feet square, inside floor measure, has 12-inch side walls and is 6 feet 6 inches from top of floor to top of ridge board. The subframing is made and both floors laid before the upper part of the building is put together. The sills

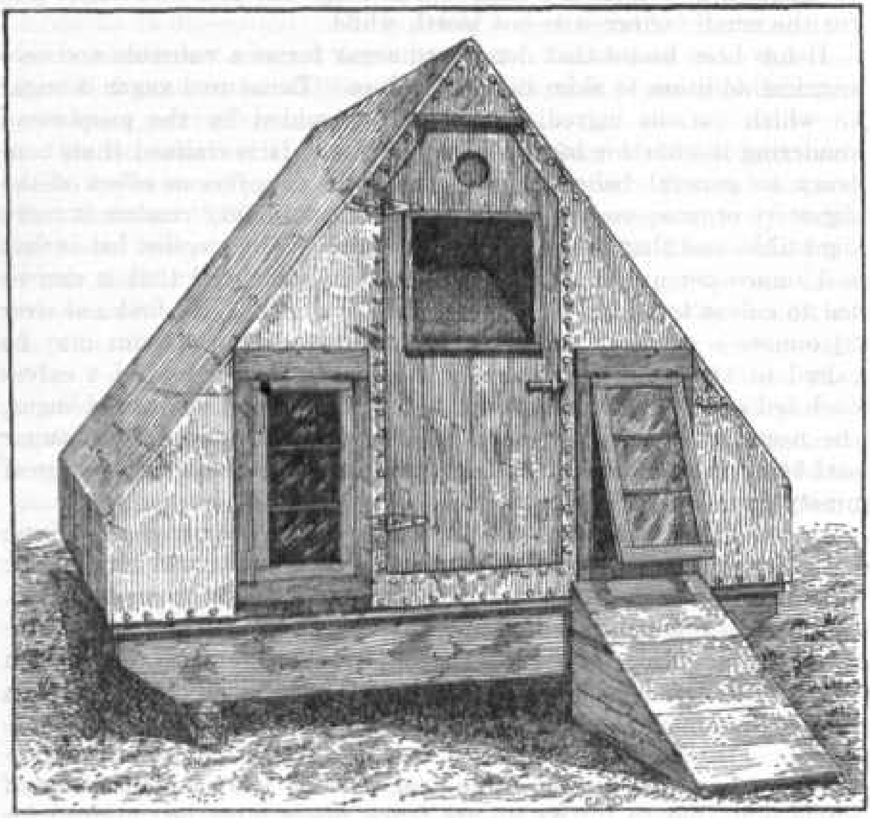

FIG. 5.—"A" type of colony brooder house.

are gotten out first. They are made of 2 by 12 inch stock and are cut 8 feet long, with a bevel at each end to form runners or shoes upon which to draw the house about when desired.

An opening of 8¾ inches by 12$\frac{3}{16}$ inches is cut in the rear runner to admit the burner box. The top of this opening is 1½ inches from the top of the runner and has a ½-inch slit sawed into the runner horizontally from the two upper corners for the purpose of admitting the flange, or projection, of the upper edge of the burner box. A piece is cut from the runner directly over the center of this opening to admit the collar, which is on top of the burner box. The piece is sawed out on a miter so that it can be

replaced and secured by a single screw. The opening made by removing this piece is 5 inches in the clear.

A strip 1 inch square and 18 inches long is nailed to the inside of the runner 1 inch below the lower edge of the opening, for supporting the rear end of the insulating box.

The floor joists, four in number, are made of 2 by 4 inch stock, cut 8 feet long, and are fitted into the runners with a half joint. This gives a strong subframe that is not likely to get out of square when drawn over uneven ground. After fitting the joists into the runners and securely nailing with 20d. nails, the work is leveled, squared, and tied by means of a 1-inch board nailed diagonally across the joists.

The support for the burner box is then put in. It is made of three pieces of 2 by 4 spiked to the rear runner and to the two center joists. It is placed flush with the top of the joists and runner so that the flooring can be nailed to it. The inside dimensions, $13\frac{1}{2}$ by $24\frac{1}{2}$ inches, are such as to allow the flange of the burner box to slide in easily. The flange rests on $\frac{1}{2}$ by 1 inch strips, which are nailed $1\frac{9}{16}$ inches below the top of the 2 by 4's forming the support. This leaves a space of $1\frac{1}{2}$ inches between the top of the burner box and the floor of the house, which prevents the floor from becoming too warm and serves as a chamber in which to warm the fresh air that is admitted for ventilating the hover. The cool fresh air is taken from beneath the house through four 1-inch holes bored in the 2 by 4 supports. It is warmed by passing over the metal top of the burner box and as it expands is forced upward around the stem and down upon the chicks.

The insulating box is made of $\frac{7}{8}$-inch matched pine flooring and is supported at the rear by resting on the strip at the bottom of the runner and in front by hooks and eyes, such as are used for screen doors, to the support.

The first or sub floor is made of 1-inch matched hemlock siding and is laid diagonally, which helps to stiffen the building. The finished floor is made of $\frac{7}{8}$-inch sap (white) pine flooring. This is blind-nailed and is laid over a layer of building paper.

The studs are now put up. These, together with the plates, rafters, and ridge board, are made of $\frac{7}{8}$ by $2\frac{3}{4}$ inch clear hemlock stock. The studs are placed flush with the outer edge of the floor and are toe-nailed to it. The plates are laid on and nailed to the ends of the studs. The rafters are first nailed to the ridge board and then put in place and toe-nailed to the plates. These are held in place temporarily by nailing a strip of board diagonally across them. The front and rear studs are fitted in place and then the boarding put on. The boards are put on horizontally and overlap the floor 2 inches.

The building is inclosed with $\frac{7}{8}$-inch matched siding, planed one side, with the smooth side turned in. The boards for sides and roof are cut in 8-foot lengths, and since the house is to be 8 feet square inside, a small space is left at each corner which is filled by a quarter-round molding, thus making it possible to use 16-foot stock without waste. The ends are boarded up solid, with the exception of the door opening. After the paper has been put on the casings for the windows are nailed in place and then the openings cut. By this method of construction no studs are required for the windows.

Best results have been secured by running the strips of roofing paper vertically instead of horizontally, as is generally recommended. The laps are made to come over the rafters and are covered with a $\frac{3}{4}$ by 2 inch batten. It requires much less time to put the paper on in this way and it presents a more pleasing appearance.

After the house is inclosed and doors and windows fitted and hung, the heater is put in place. (Figs. 6 and 7.) To do this a circular opening, 6 inches in diameter, is cut in the floor toward the back of the house. The center of this opening is 19

inches from the back of the house and 4 feet from either side, inside measurement. The chick guard fits into this opening. The burner box is slid in from the back of the house (B B, fig. 8), and the stem telescoped down over the collar. The radiator is secured to the hover and telescopes over the top of the stem. The opening for the vent pipe in the back of the house is located so as to correspond exactly to the vent pipe coming out of the radiator. Great care should be exercised in installing the heater, as any loose fitting connections would cause leakage of gases into the hover.

The hover is made of ⅞-inch matched pine flooring, planed both surfaces, and is held to the back of the house with detachable hinges. It can be raised and held up out of the way with a hook and eye or may be entirely removed while cleaning the floor of the house. The front is supported by two pieces of broomstick serving as legs at each corner. It is inclosed by a double curtain of table oilcloth, unfinished surfaces together, reaching to within 1 inch of the floor. This is made into a fringe by a series of vertical slits 4 inches apart, extending upward 6 inches. The slits in the outer thickness of the curtain are made to break joints with those of the inner. Table oilcloth is used in place of felt or woven cloth because the chicks eat the felt and are likely to become entangled in the ravelings from the woven cloth. It is also easier to keep clean. A hole is bored 4½ inches from the front of the hover and the thermometer inserted so that the bulb is within 3 inches of the floor.

The gasoline tank is put in place by cutting a circular opening 8½ inches in diameter through the rear gable of the house. The inner end of the tank is supported by a piece of 1 by 6 inch board hollowed out to fit the can and fastened to the rafters. (Fig. 6.) It is secured at the rear end by nailing the square galvanized-iron collar to the outside of the house and at the inner end by wiring to the 1 by 6 inch support. The iron piping is now fitted together and the burner connected. All threads are well soaped over with soft soap before screwing together. When the burner is in place it should be so located as to be directly underneath the center of the stem. (Fig. 6.)

Figure 5 shows the colony house completed. * * * The runners, as shown, are 12 inches high and are placed in the front and rear of the house. Runners 6 inches high have been tried with satisfactory results. The runners may be placed on the sides instead of the ends. This is sometimes advisable when the houses are to be used in orchards, because it allows the house to be drawn between the rows of trees with less danger of striking. Whatever the height of the runner, the burner box should be taken out before moving the house. If left in, it might be bent out of shape by striking stones or uneven places in the land. To remove burner box, raise hover, lift out stem, disconnect piping at union coupling, and withdraw box. Care should be taken that the wheel valve next to the tank is closed before disconnecting the pipe and that the lead gasket is not lost out of the union coupling.

The cost of materials for the house at prices prevailing in Ithaca, N. Y., is $22.46. Two days' work by a carpenter is sufficient to build the house. The heater complete costs $10 in Ithaca, N. Y.; it can be made by any good tinsmith from the working plan shown in figure 6, and includes all the metal parts shown in the figure except the filling can and also includes a burner. The form of burner that was found most satisfactory was one that "gives a cone-shaped blaze directed up into the radiator * * * instead of being sent out in jets at right angles to the burner. It gives more complete combustion than the cap type of burner and is capable of a wider range of temperature; that is, it can be turned very low for use in mild weather,

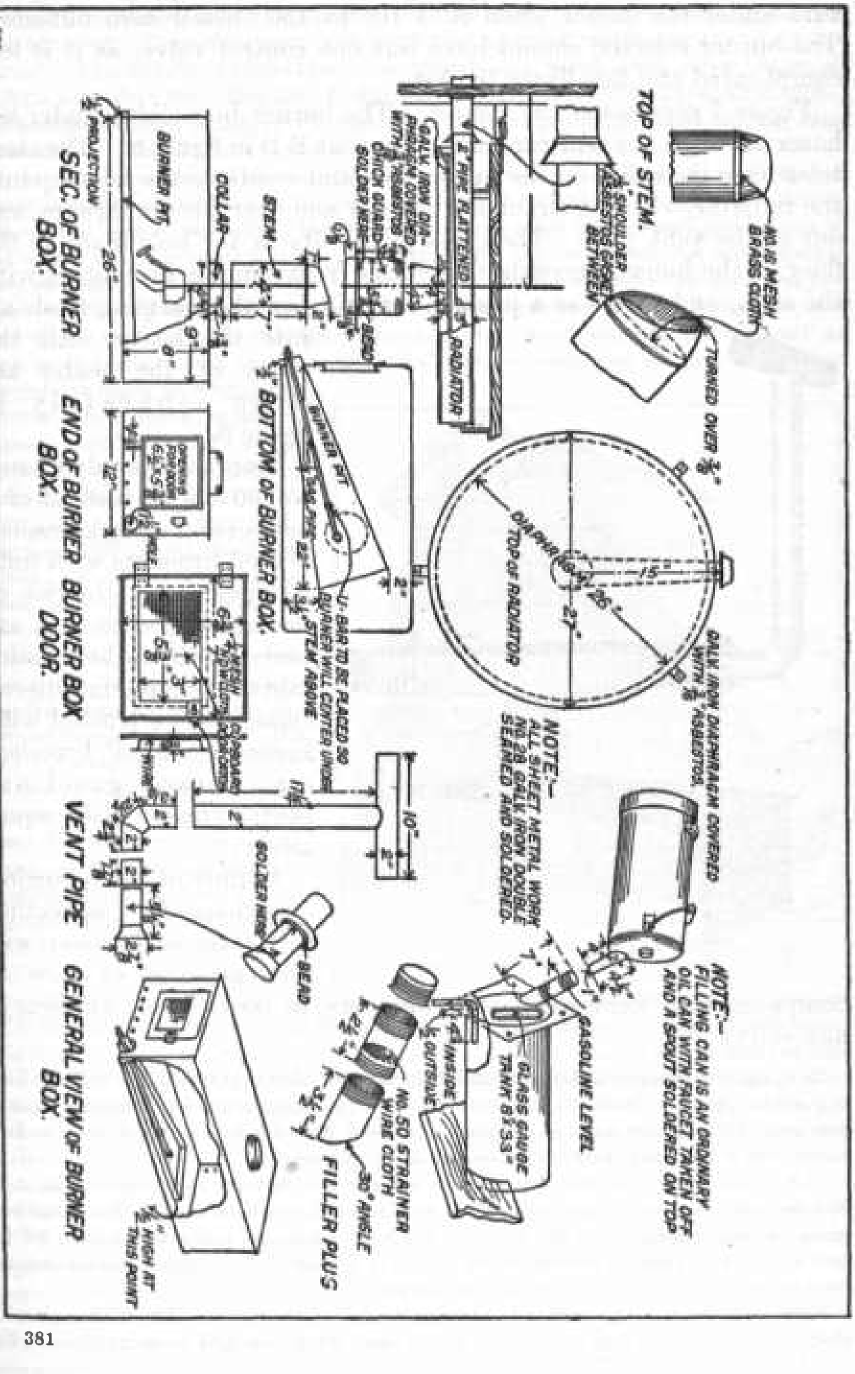

Fig. 6.—Details of construction of heating apparatus for brooder house.

or will give a flame sufficiently large to maintain the proper temperature under the hover when it is 10° to 150° below zero outside." The burner selected should have but one control valve, as it is less complicated and less likely to clog.

Figure 7 represents the heater. The burner box slides under the house through the rear runner as shown at B B in figure 8. The stem telescopes the collar on the burner box and conducts the heat up into the radiator, where it circulates upward and over the diaphragm, and out of the vent pipe. The chick guard fits in the hole made in the floor of the house, prevents the chicks from coming in contact with the stem, and serves as a passage for bringing the warmed, fresh air into the hover. All the parts of the heater are shown separately in figure 6.

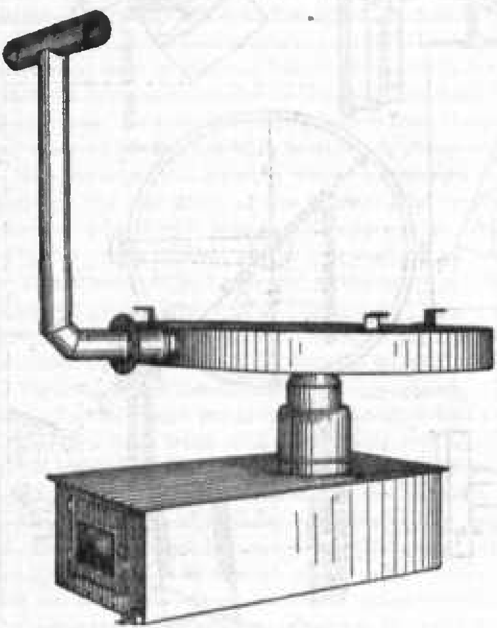
FIG. 7.—Gasoline heater used in brooder house.

Since there is only 1 flame to 200 chicks, instead of 4 as in case of using kerosene-heated brooders with only 50 chicks each, the risk of fire is reduced to that extent, and the authors maintain that anyone intelligent enough to be trusted with kerosene-heated brooders can manage gasoline-heated ones with equal safety.

A study of the following directions for operating this form of brooder will give an idea of how it compares with kerosene-heated brooders in cost, labor, efficiency, and safety:

To operate this house in January and February weather requires about half a gallon of gasoline per day costing at the present rate of 15 cents per gallon, less than 7 cents per day. During the warmer weather, April and May, the cost is much less, as low sometimes as 2 cents per day to brood the 200 chickens. * * *

The brooder is run for the first week or ten days so that the thermometer, located as mentioned above, gives a reading of 90° F., at the same time the thermometers placed under other parts of the hover would show a range of temperature from 90° to 103° F., thus making it possible for the chicks to get almost any degree of temperature from 60 out in the room, to 103 under the hover.

Figure 8 shows how the tank is filled from the rear of the house. The burner should always be turned out and the wheel valve closed while the tank is being filled. To

light the burner, open the wheel valve (W W, fig. 8), and the control valve, and allow the gasoline to fill the generating cup [nearly full], then close. Light the gasoline and allow it to burn out. Open the control valve and hold a lighted match over the top of the burner. This will give a bright blue, cone-shaped flame, which should never be turned so high as to show red. Regulate to the desired temperature with the control valve.

There is no danger whatsoever in operating a gasoline burner provided ordinary care is exercised. The common points of error often resulting disastrously are: (a) Allowing too much gasoline to run into the generating cup; (b) applying a match to the generating cup before the control valve is closed; (c) attempting to light the burner after it has been blown out by the wind or in some other manner and the bottom of the burner box is covered with gasoline. With this type of heater this occurrence is very rare, since the burner is placed back under the house where the wind can not reach it. Should the flame by any accident be extinguished and the burner become cool and so waste gasoline into the burner box, the control valve should be closed as soon as it is discovered and the gasoline allowed to evaporate entirely before any attempt is made to relight the burner. As an extra precaution a basin may be placed outside under the drip to prevent waste and also to avoid gasoline filtering into the soil. A tin flashing should be placed about and below the burner box on the back side of the house as an extra precaution against fire.

FIG. 8.—Method of filling gasoline heater in place.

Should any difficulty be experienced in getting a large enough flame to maintain the proper temperature under the hover during cold weather, the burner should be examined for stoppage. It sometimes happens that little particles of sediment in the gasoline clog the opening at the needle end of the control valve. This can be remedied by closing the control valve and forcing the point of the needle through the opening in the valve seat. This will clear away any obstruction that might be there. It might be difficult to get a sufficiently large blaze because the opening above referred to is too small. This may be remedied by opening the control valve so that the point of the needle will be back out of the way and then drawing a file at right angles across the hole, thus enlarging it. * * *

See that the house stands level. If it tips forward, the gasoline which would flow if the flame should be extinguished would remain in the burner box instead of escaping outside by the trough provided for the purpose. (Fig. 6.) * * *

While there is less danger from fire with gasoline when used as here recommended, nevertheless it is well to be prepared for fire by having a fire extinguisher or water supply at hand in case of need. It will be a wise precaution and profitable investment, whatever system of brooding is employed. * * *

Do not leave the hover raised without first extinguishing the flame. The wind is likely to blow down the stem of the heater and put out the flame, which would allow the gasoline to escape.

Never ignite the burner while there is gasoline or gasoline vapor free inside the burner box. If gasoline has escaped, wipe out the burner box thoroughly and allow a little time to elapse before igniting in order to let the vapor escape from the heater drum, thus avoiding an explosion of the gas.

The authors give a table showing the temperature maintained by one of these gasoline heaters for a period of 29½ days in the month of March. The average outside temperature was 40°, the average temperature of the brooder outside of the hover was 48°, and under the hover 89°. The cost of brooding one chick for sixty days, the time estimated that it needs heat, is 1.8 cents.

The estimated time saved during a brooding season is fifteen hours, which at 15 cents an hour is equal to $2.25.

MEASURING ACIDITY IN CHEESE MAKING AND BUTTER MAKING.[a]

A simple, accurate means of measuring acidity is of great importance to butter and cheese makers, because, as C. A. Publow, of the New York Cornell Station, points out, "one of the most important factors in the manufacture of cheese and butter is the control of acidity at all times." A number of methods have been devised and used for this purpose. In a recent circular of the New York Cornell Station Mr. Publow describes a new method in which, he believes, "most of the defects in other tests have been eliminated," and which contains features which make it "the most simple, durable, and accurate apparatus yet devised for the use of cheese makers in testing for acidity."

The apparatus and its method of use is described as follows:

THE ACIDIMETER.

The apparatus (see fig. 9) consists of—

1. A plain 5-pint bottle with an opening in the bottom, through which a brass pipe is connected in such a manner as to prevent leakage.
2. A small 2-ounce wash bottle, fastened to the neck of the large bottle by a copper band, and connected with rubber corks and glass tubing.
3. A plain 10 cubic centimeter burette, graduated in tenths, and a simple wire burette holder.
4. A straight, nonbulbous, 9-gram pipette, which is easily cleaned.
5. A simple rubber-stoppered dropper bottle.
6. A plain white cup and a stirring rod.
7. A small bottle containing 50 cubic centimeters of a solution of caustic soda, which, when added to 2,250 cubic centimeters of water, makes 2,300 cubic centimeters of a one-tenth normal alkaline solution. The large bottle is marked to show the level of 2,300 cubic centimeters in order to save measuring with a graduate each time.
8. A small bottle of phenolphthalein, to be used as an indicator.

Very few of the cheese makers and butter makers are able to make and standardize their own solutions to be used in such tests. For this reason a concentrated solution is advised, 50 cubic centimeters of which is sufficient to make 2,300 cubic centi-

[a] Compiled from New York Cornell Sta. Circ. 7.

meters of a one-tenth normal alkaline solution. This small amount is not costly and can be sent through the mails for a few cents. When tightly corked this solution will retain its strength indefinitely, so that it can be kept in stock in almost any place.

The indicator is made by dissolving 5 grams of dry phenolphthalein in 100 cubic centimeters of 50 per cent alcohol. The commercial alcohol, which is about 95 per cent pure, can be used by diluting 50 cubic centimeters of it with 50 cubic centimeters of water. It can be purchased ready for use from dairy supply houses.

The preparation and successful handling of a good commercial starter for use in cheese making or butter making depends very largely upon the amount of acid allowed to develop in the starter from day to day. Uniformity is one of the great factors of success in dairy work, especially in the manufacturing department, and one need only know this to appreciate the value of any simple test that will enable him to measure the acid in his product as closely as one one-hundredth of 1 per cent.

By the use of such a test one is guided in controlling temperature and bacterial life associated with the manufacturing process, so that if the raw material reaches the cheese maker or butter maker in good condition there is no reason why he should not be able to turn out butter or cheese of uniform quality each day.

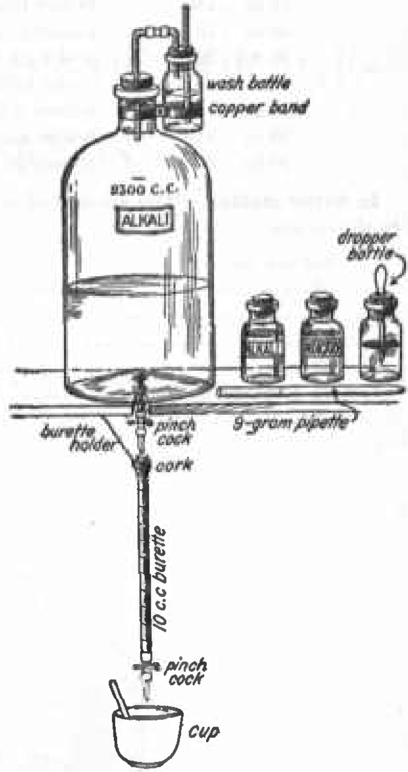

FIG. 9.—Apparatus for determining acidity in milk and cream.

DIRECTIONS FOR USING THE ACIDIMETER.

How to set up the test.—In a convenient place erect a small shelf to support the large bottle. Cut a notch in the front or back of the shelf to allow the brass pipe to pass through.

Then add the contents of the small bottle of alkali to the large bottle, rinsing the small bottle several times, and each time pouring the rinsings into the large bottle. Then add soft water to the large bottle until the level reaches the mark filed on the bottle. You will then have 2,300 cubic centimeters of a one-tenth normal alkaline solution.

The small wash bottle attached to the neck of the larger one should be half filled with this solution. Then the rubber and glass connections are made between the two bottles.

The burette holder is fastened underneath the shelf so that the alkali from the large bottle can enter it. The dropper bottle is then filled with indicator.

To use the test.—Measure with a pipette 9 grams of the substance (milk, whey, cream, or starter) which you wish to test, and place it in the white cup. Add two drops of the phenolphthalein indicator. Then allow the alkaline solution to run into the cup from the burette, one drop at a time, until the fluid in the cup, which is being constantly stirred, shows a very faint pink color. By reading the graduations on the burette we can ascertain the amount of acid in the substance tested. Each one-tenth cubic centimeter of alkali represents one one-hundredth per cent of acid in the fluid.

AMOUNT OF ACID TO BE DEVELOPED AT EACH STAGE.

In cheese making.—The amount of lactic acid developed depends largely on the condition of the curd, and no fixed amount can be accepted as a set rule. Other conditions equal, the acidity should be uniform from day to day.

The proper firming of the curd in the whey before too much acid has been formed is the secret of cheddar cheese making, and with this fact in mind, the following directions should give accurate results:

(Export cheese.) Per cent.		(Home-made cheese.) Per cent.
0.20 to 0.21	before adding rennet	0.18 to 0.20
.14 to .145	before heating curd	.13 to .14
.16 to .18	before removing whey	.15 to .17
.24 to .30	when all whey is removed and curd is packed	.23 to .26
.65 to .75	before milling	.60 to .65
.90 to .110	before salting	.65 to .90
.70 to .80	in starter	.70 to .80

In butter making.—The amount of acid should vary with the amount of butter fat in the cream.

Per cent fat.	Per cent acid.
20	0.72
30	.63
40	.54
50	.45
In commercial starter	0.70 to .80